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RECONSTRUCTION OF A NINETEENTH CENTURY MAKASSAN *PERAHU*

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ABSTRACT

Research undertaken to reconstruct the design of a 19th century Makassan (South Sulawesi) traditional sailing vessel is described. This research draws on historical sources, interviews with contemporary Indonesian boat-builders and sailors, and the personal observations of the author. Two sets of line drawings and three sketches are presented to indicate the general proportions and arrangements of a typical 19th century Makassan *perahu padewakang*

KEYWORDS: *perahu*, sailing boat, reconstruction, maritime technology, 19th century, *Makassan/Macassan*, South Sulawesi, Indonesia.

INTRODUCTION

This paper provides an account of research undertaken to reconstruct the appearance and design of a 19th century Makassan sailing boat or *perahu*, such as those that formerly frequented the coast of north Australia in search of *teripang* (otherwise known as sea cucumber or beche-de-mer). This research was initially conducted in order to build a model for the collections of the Museums and Art Galleries of the Northern Territory. Further research was later conducted as part of an Australian Bicentennial Celebration project which will involve the construction of a full-sized replica of a Makassan *teripang perahu*. This vessel will be built by South Sulawesi boat-builders using traditional methods, and will be sailed from Ujung Pandang (Makassar) to the Northern Territory in 1988.

For detailed information on the history of north Australi's *teripang* industry, and on the varieties of traditional and contemporary Indonesian sailing vessels, the reader is referred to the work of Macknight (1976,1980) and Horridge (1981,1985,1986).

NOMENCLATURE

The word *Makassan* is used here as an adjective and equates with *Macassan* as defined by Macknight (1976:1-2). The Makassan language is here called *bahasa Makassar*. The use of *k* in both these instances conforms to current Indonesian orthography.

Similarly, the contemporary Indonesian spelling of the word *perahu* is used in preference to the English derivative *prahu*. In Indonesian usage, *perahu* is used to indicate both single and plural forms, and this practice is followed here.

The spelling of contemporary *perahu* types is taken from the registration papers of perahu seen by the author. *Padewakang* is a transliteration of Bugis spelling (Macknight 1980:119).

Except where specifically ascribed to a particular language, the foreign nautical terms used in this article are those commonly employed by speakers of both *bahasa Makassar* and *Bugis*, and in use in *Bahasa Indonesia*, the national language of Indonesia. No attempt is made to identify the language from which the terms originate.

RESEARCH METHOD

The first program of research dealt mainly with the general arrangement and appearance of 19th century *teripang perahu*, in order to abstract a generalised design. The subsequent research attempted to analyse the relative proportions of 19th century *perahu*, and to then compare these with the proportions of contemporary South Sulawesi *perahu* displaying the closest degree of similarity to their 19th century counterparts. This latter research was undertaken in order to yield comparative data that could be clearly communicated to and discussed with present-day traditional boat-builders in South Sulawesi who are familiar with relative proportions but do not work from scaled plans.

The results of these two programs of research are presented in this paper in combined form.

Research material was drawn from a number of sources. These included 19th century written descriptions, drawings and paintings; modern photographs and drawings of 19th century models; and early 20th century descriptions and depictions. Although the information provided in these sources is sometimes incomplete and in some cases contradictory, these deficiences were overcome where necessary by recourse to 20th century boat construction and design practices, and inference based on practical seamanship. In the following section, the major pictorial sources employed in the analysis are itemised. It should be noted that a number of other pictorial sources available were rejected on the grounds of unclear or unlikely detail. A case in point is the drawing by L. Le Breton which dates to 1838 and is reproduced in Macknight (1976:Pl. 33). This shows a vessel with a bipod instead of tripod mast, and no sign of the usual double rudders which characterise these boats.

PICTORIAL SOURCES USED IN ANALYSIS OF NINETEENTH CENTURY PERAHU PROPORTIONS.

Items A and B. 2 pencil drawings entitled *The English Company's Islands: Malay Proas* by William Westall, landscape artist on board H.M.S. *Investigator* during the circumnavigation of Australia by Captain Mathew Flinders RN between 1801-1803; held in the collection of the Royal Commonwealth Society, London, and reproduced in Perry and Simpson (1962:Plates 109-110). These vessels originated from South Sulawesi and were part of a *teripang* collecting fleet encountered by the *Investigator* off the English Company's Islands in 1803 (see Flinders 1814 (1966):230 for further details).

These sketches are detailed and apparently accurate representations of the *perahu padewakang*-type, and display all the distinctive features of traditional South Sulawesi sailing vessels. They have low bluff bows with a bulkhead just abaft the bow to raise the freeboard; the masts are tripod-form; the sails are of the tilted rectangular variety (*layar tanja*); and the rudders are clearly shown mounted on the quarters, fitted with the tillers pointing aft. The two vessels are also depicted with different styles of prow finial, styles which are still found in South Sulawesi and which can be ascribed to particular areas. The low simple prow in **A**, is similar to the older *perahu lete* from several islands in the Makassar Strait while **B** shows the high curving prow popular on the mainland around Tanah Beru.

Item C. Ink drawing by Chris Snoek from a photograph of a model dated ca. 1840 (Horridge 1979:29) of a *perahu* of the *padewakang abi jawa* type, held in the collections of the Prins Hendrik Museum at Rotterdam (Catalogue number:29568) and reproduced in Horridge (1979:Fig. 21). This model was recently severely damaged in the Museum (personal communication from Horridge 23.7.87). A photograph of this model is also produced in Mulia and Hidding (n.d.:1027).

This is a well constructed planked model. The accuracy of its plank pattern has been confirmed by Horridge (1979:16) in the course of interviews with South Sulawesi boat builders. The vessel is very high-sided, with a top gallant deck built over the whole hull. Modern boat builders have identified it as a war vessel (personal communication with builders in Ujung Pandang, 1986).

Item D. Pencil drawing by Chris Snoek from a photograph of a late nineteenth century *padewakang abi tarus* model held in the collections of the National Museum, Jakarta (Catalogue number: 27170), and published in Horridge (1979: Fig. 26).

This item is easily recognisable as a South Sulawesi *perahu* for stylistic and design reasons, in as far as they can be assessed by projection from the oblique bow-on view of the vessel provided by Snoek. It is probably a model carved by a *perahu* sailor, and credence is lent to this view by reference to the several 20th century *perahu* models carved by *perahu* sailors that are housed in the collections of the Museums and Art Galleries of the Northern Territory (Catalogue numbers: IND 26,28,29,30 and 435.) While some are fine models, all show remarkable disregard for accuracy of relative proportions.

Item E. Black and white photograph entitled *Segelboot von Aloresen, den Vermittlern des Verkehrs mit Flores und Wetar* [Alorese sailing boat, the means of commerce with Flores and Wetar], published in Elbert (1912: Fig. 138). While there is nothing to positively connect this boat with South

Sulawesi, its design is very much in the South Sulawesi tradition, which is hardly unusual when one considers that there are established communities of South Sulawesi maritime peoples on Alor, notably the community of Kampung Makassar at Kalabahi. The styling and position of the large decorated board on this Alorese *perahu* is very similar to that found on a model of a *perahu padewakang* originally illustrated in Matthes' Atlas dated 1885, and reproduced in Horridge (1979: Fig. 22).

Item F. Sketch of a *padewakang*-type *perahu* by Alfred Russell Wallace, *ca.* ? 1860, unpublished. The provenance of this item is not recorded, but it is derived from material collected by Peter Spillett (Research Associate with the N.T. Museum) in Great Britain. This sketch, while rather crude and difficult to interpret, is particularly useful when interpreted in conjunction with Wallace's written description (see Wallace 1869:310-317) .

Item G. Plan drawings of the construction details and lines of a Bugis *perahu palari, Bintang Satoe* ("One Star" according to the source but probably "First Star"), taken off by William M. Blake in October 1928 in Singapore harbour, and published in Blake (1929:74). This vessel was part of the freight traffic of the Indonesian archipelago, and was described as 30 years old at the time of Blake's documentation, which gives it a construction date of *ca.* 1898.

The *perahu palari* or *palari pinis*, as it is otherwise called, is considered to be a recent development resulting from the modification of traditional *perahu* to accommodate the European standing gaff ketch rig (see Horridge 1979:30; Macknight 1976:149). With respect to this, it might be significant that *Bintang Satoe* has her main mast positioned as if for a traditional *tanja* rig, which is usually positioned further aft than is normal for the *pinis*-style ketch rig.

Item H. Line drawing by C.A. Gibson-Hill entitled *Profile of a ketch-rigged Palari from Southern Celebes,* published in Gibson-Hill (1950:11). Gibson-Hill notes (ibid): "The drawing shows a boat with the older pattern bows and a tripod foremast".

Item I. Photograph of a row of four beached *perahu* taken *ca.* 1910 in South Sulawesi, held in the collections of the Royal Tropical Institute, Rotterdam. A copy of this photograph was kindly provided by Professor Adrian Horridge. The vessels shown in this photograph are probably *perahu palari* rather than *padewakang* because they have heavy bowsprits with bobstays necessary to rig the forestays of a ketch but not required by *tanja* rigged vessels that have no forestay and jibs set "flying".

Item J. Watercolour by Lieut. Owen Stanley of H.M.S. *Britomart* entitled *Prows off Port Essington, February 1840.* This item is held in the collections of the State Library of New South Wales, Sydney, and has been published in black and white in Hawkins (1982:17) and in Macknight (1969: facing page 155).

Item K Black and white photograph of a relatively small *perahu of about the size of modern perahu patorani* under sail, taken in the vicinity of Ujung Pandang *ca.* 1900 and held in the collection of the Royal Tropical Institute, Rotterdam, The Netherlands.

Item L. Black and white photograph of a relatively small *perahu* (about the size of modern *perahu patorani*) moored in Ujung Pandang *ca.* 1920. This photograph is held in the collections of the I La Galigo Museum, Ujung Pandang, Sulawesi, Indonesia.

Item M. Black and white photograph of a model of a Butonese *perahu palari* entitled *Modell eines butonesischen Palari-Bootes als Kinderspielzeig* [Model of a Butonese palari boat, child's toy], published in Elbert (1911: Fig. 116). This is a very plausible and well-detailed model, although the rig is damaged and the rudders are mounted backwards.

GENERAL HULL FORM: COMMENTS

The large South Sulawesi *perahu* of the 19th century probably exhibited as much variation of hull form as do the 20th century vessels. It is possible for two vessels of the same type and the same length to vary in tonnage by as much as two to one. The various generic names for the 19th century vessels, *padewakang, bondeng, lambere, palari,* etc. are said to have been applied to various hull forms (Macknight 1976: 26; Elbert 1912: 221).

The *perahu* that came down to North Australia on *teripang* collecting voyages carried large crews, provisions for several months, materials for setting up camps on shore (including prefabricated houses), spare gear and a number of large canoes.

Each vessel carried six canoes of over two tons, plus a number of smaller canoes. According to the Northern Territory Government Resident's report of 1906 (1888-1911:381):

"each of these proas have six large canoes each of which pays 20s for licence fee, being over 2 tons burden".

The *padewakang* that carried these canoes must have been fairly burdensome craft.

European observers saw Makassan *perahu* as vessels "with great beam and high sides" (Kolff 1840, quoted Horridge 1979: 27), and the contemporary illustrations tend to confirm this, although it must be remembered that by the mid-19th century, European sailing vessel design was changing towards an emphasis on very narrow and low relative proportions.

Many Makassan *perahu* had bamboo slatting in place of a permanent deck. They would have needed high freeboard to be seaworthy since they could not safely take seas over the rail.

ANALYSIS OF HULL FORM AND COMPARISON WITH A MODERN *PERAHU PATORANI*

The modern *perahu patorani* used here for comparison is *Sinar Galesong* from Galesong, South Sulawesi. Lines were taken off by the author and Dr Peter Murray of the Museums and Art Galleries of the Northern Territory, in November 1984 (Fig. 16).

Sinar Galesong appeared to be a typical example of a *patorani*, a type of *perahu* which has fairly uniform size and hull form. The *perahu patorani* retains most traditional 19th century features, including the *tanja* rig, tripod masts, double rudders, a low stepped down bow (*selompeng*), and a rockered keel curving into the stem and sternpost. Details of its construction are discussed further on.

The Stem. The stem and bow profiles were traced from pictorial items **A** to **I**, and these are shown in Figure 1. The angle of rake of the stem was measured from the tracings in Figure 1 by drawing a straight line from the forward edge of the stem at the waterline to a point on the forward edge of the stem at the height of the top of the rabbet; the angle between this line and a horizontal projection of the water-line was measured. This is shown in Figure 2. In some cases it was necessary to estimate a water-line, and this was done by eye. No measurement was taken from **D** because the drawing does not provide a profile view of the stem. The resulting stem rake angles are:

A: 53°	F: 56°
B: 55°	G: 57°
C: 56°	H: 47°
D: No measurement	I: 56°
E: 50°	

The range of angles is small — only 10°, or 7° if **H**, the most recent example (1950), is discounted. The average angle is 53.75° or 54.75° if **H** is discounted. The angle for the modern *perahu patorani* is approximately 45°.

The Prow. All the pictorial sources show a projection of the stem above the rabbet and the foredeck. In each case this projection reaches a height just below the break of the sheer at the *selompeng* (Fig. 2). The only clear exception is **M** where the projection is higher. There are a variety of styles. In the 20th century *perahu patorani, pajala* or *bisean* the projection is considerably higher.

Cut-away in the Forefoot. Cut-away in the forefoot is the curving of the stem into the keel. All traditional South Sulawesi designs show considerable cut-away below the water-line, and this will be discussed later under the heading "Rocker". About half the pictorial sources **A** to **M** show the cut-away starting above the water-line, the other half show the stem (and the rabbet) straight from the water-line.

Perahu patorani all show very considerable cut-away at the water-line. Larger modern *perahu such as perahu bago, palari,* and *lete* are often straight stemmed at the water-line.

Foredeck or *Lapara*. The length of the foredeck was assessed as a proportion of the hull length measured between the top of the rabbet forward to the top of the rabbet aft (see Fig. 3), with the following results:

A: 0.048	H: 09.062
B: 0.065	I: No measurement possible
C: 0.077	J:0.064
D: 0.083	K: 0.068
E: 0.083	L: No measurement
F: 0.044	M: No measurement
G: 0.070	

These figures show moderate variation and give an average of approximately 0.066. The figure for the *perahu patorani* is much lower at 0.028.

The *lapara* is usually horizontal or parallel to the water-line on the *padewakang* and

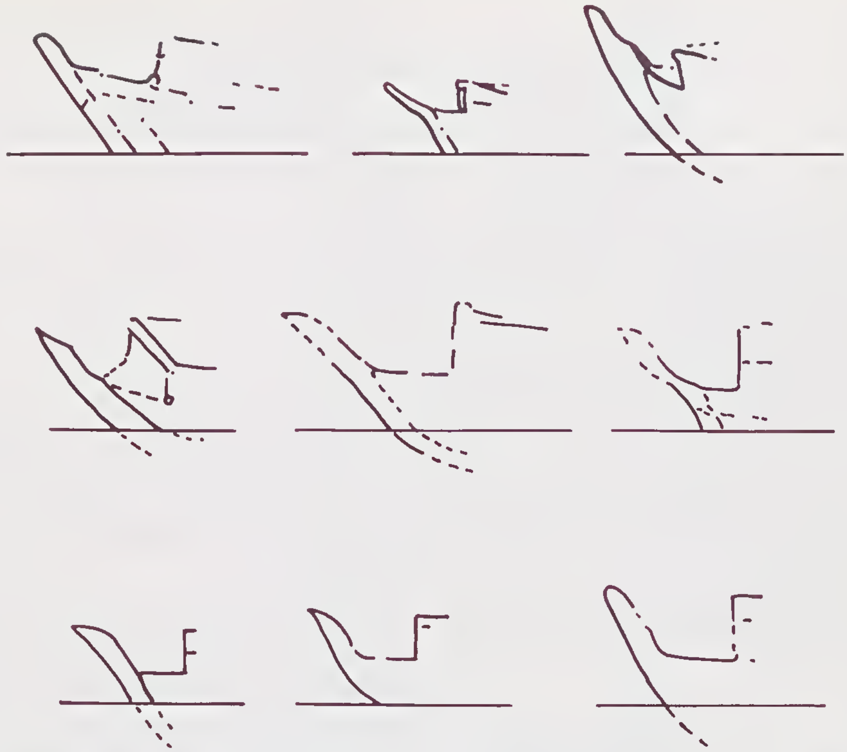

Fig. 1. Stem profiles of nine South Sulawesi *perahu* traced from the pictorial sources listed as examples **A** to **I**.

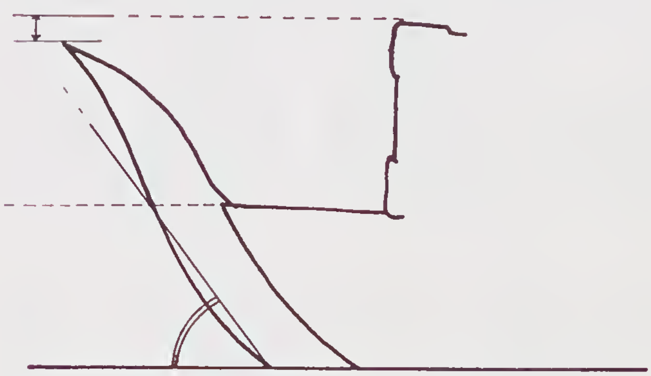

Fig. 2. Measurement of the stem rake angle and prow height.

does not follow the sheer as it does on *perahu patorani*.

The Selompeng. The height of the *selompeng* (the foreward bulkhead) above the *lapara* (Fig. 3) was analysed as a proportion of length measured between rabbets. This produced the following figures:

A: 0.048	G: 0.062
B: 0.050	H: 0.062
C: 0.043	I: No measurement
D: 0.090	J: 0.030
E: 0.048	K: 0.066
F: 0.074	M: 0.050

This gives an average of 0.055.

The figure for the *patorani Sinar Galesong* is lower at 0.048, and this figure is probably high for *perahu patorani*.

The height of the *selompeng* as a proportion of freeboard at the *lapara* (Fig. 3) was also calculated, in some cases using an arbitary water-line:

A: 0.75	I: 0.95
B: 1.0	J: 0.66
C: 0.9	K: No measurement (vessel deep laden)
D: 1.25	L: No measurement (bow obscured)
E: 1.27	M: No measurement (bow obseured)
F: 1.6	
G: less than 0.10	
H: 1.00	

The average figure is approximately 1. This eompares with a figure of less than 0.5 for *perahu patorani*.

Sheer. The sheer as formed by the rail or top plank is often obseured by *ambeng*, outboard planks, thatehing or spare gear as in Westall's drawings (Items **A** and **B**). Some vessels clearly have high sterns while others have approximately equal height forward and aft, and therefore have the lowest point of their sheer approximately equidistant from bow and stern (Fig. 4).

Distance from the bow to the lowest point of sheer as a proportion of length was ealeulated as follows:

A: 0.45	H: 0.30
B: 0.50	I: No measurement
C: 0.25	J: No measurement (not elear)
D: 0.30	K: 0.5 (deep laden)
E: 0.50	L: No measurement
F: less than 0.10	M: No measurement
G: less than 0.10	

These approximate figures give an average of 0.33, in no case is the lowest point of the sheer aft of midships. A *perahu patorani* in sailing trim has the low point of her sheer aft of midships, at approximately 0.55 of her length from the bow.

The Stern Post. Stern profiles were traeed (Fig. 5) and the angle of rake measured in the same way as for the stems:

A: 63°	H: 55°
B: 65°	I: —
C: 70°	J: —
D: —	K: —
E: 62	L: —
F: 78°	M: —
G: 73°	

Onee again, the most reeent example, **H**, showed the most rake. The average figure was 66.5° while an angle of around 60° seems standard for the *perahu patorani*. All stern-posts show some eurve. There are no examples of stern-posts showing more rake than the stem.

The seetion of stern post above the rabbet and aft *lapara* is in most eases tall and near vertieal. It is generally located outside the *ambeng*, and this is a very obvious differenee between the 19th century *perahu* and reeent types sueh as the *patorani*, *bago*, *palari* and *pinis* whieh all have long *ambeng* extending well aft of the stern post.

Position of the *sangkilang* rudder mounting beam. The *sangkilang* is a heavy beam that projeets out-board on both sides of the hull. It is usually positioned at the level of the aft *lapara* and marks its forward end. The port and starboard rudders are mounted in

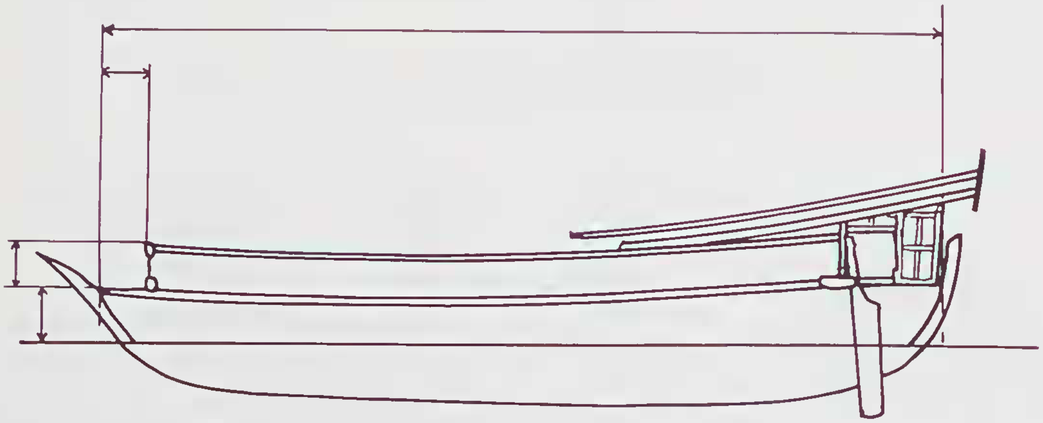

Fig. 3 Proportions of the hull's profile; hull length between rabbetts; foredeek length; *selompeng* height; freeboard at foredeek.

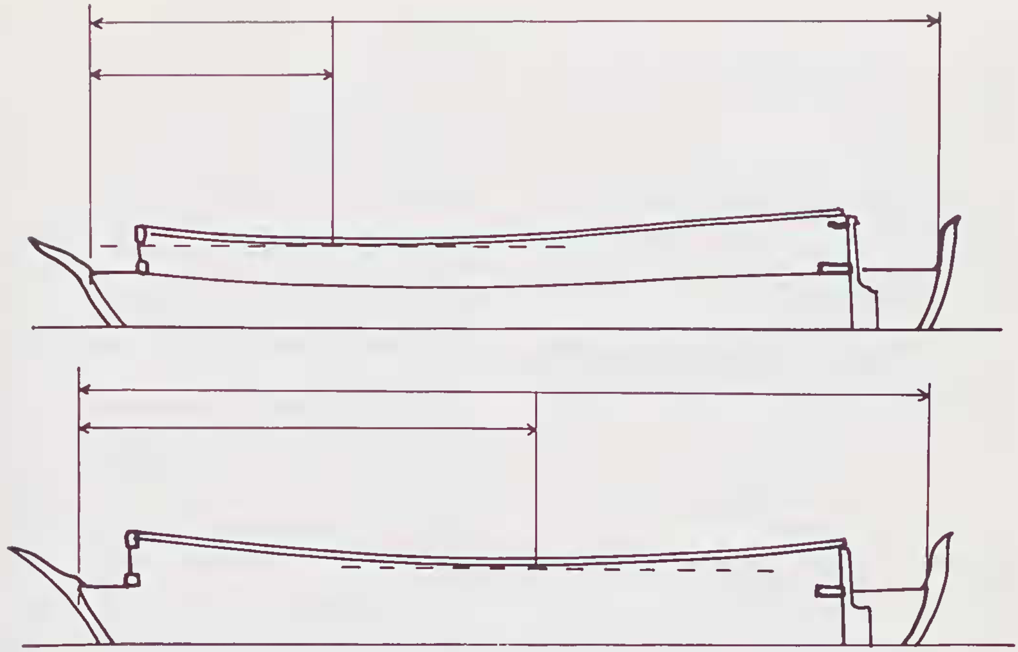

Fig. 4. Lowest point of the sheer; position measured from the bow.

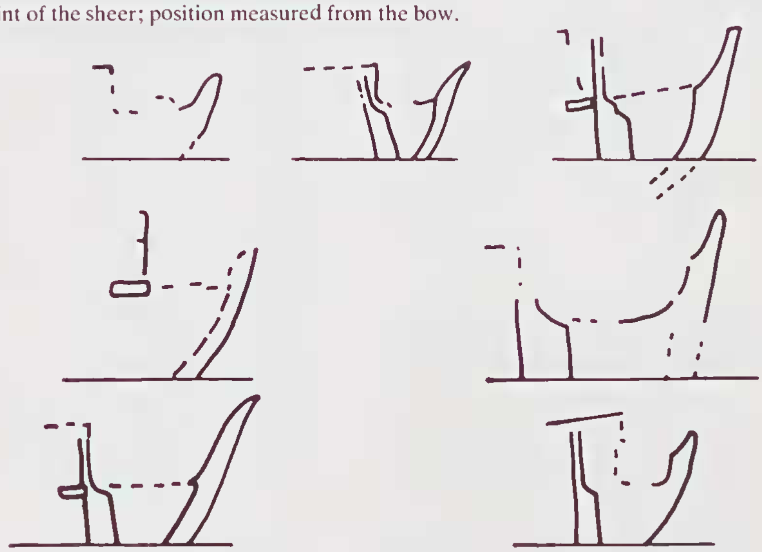

Fig. 5. Stern profiles traced from examples **A,B,C,E,F,G** and **H**.

notches on the aft side of the *sangkilang*, projecting on the port and starboard quarters. Aliskander Dembeatang, the owner and master of the *perahu patorani Sinar Galesong*, said that the correct positioning of the *sangkilang* is critical for the performance of a *perahu*. If the *sangkilang* is too far forward or too far aft, the performance will be spoiled. Aliskander said there is no formula for positioning the *sangkilang* but an experienced man could do it by eye.

The distance between the stern-post and the aft edge of the *sangkilang* was measured and calculated as a proportion of the vessel's length:

A: 0.050	H: 0.096
B: 0.088	I: No measurement
C: 0.133	J: 0.107
D: 0.142	K: No measurement
E: 0.079	L: 0.125
F: 1.148	M: 0.145
G: 0.102	

In the case of **J** where no *sangkilang* is shown, the forward edge of the helmsman's opening in the side of the *ambeng* was taken to coincide with the *sangkilang* since this is normally the case.

The average figure is 0.11 but the figure for *Sinar Galesong* is 0.06. It seems that the *sangkilang* is now positioned further aft: probably this is only possible because the *ambeng* is no longer positioned between the *sangkilang* and stern-post.

Freeboard of the aft *lapara* calculated as a proportion of the freeboard of the *lapara* forward is shown below:

A: 0.88	H: 1.0
B: 1.0	I: —
C: 1.25	J: —
D: —	K: —
E: 1.00	L: —
F: 1.50	M: —
G: 1.77	

The average is 1.2 which tends to confirm that 19th century *padewakang* were high sterned.

The figure for a *patorani*, based on measurements from *Sinar Galesong* and photographs of *patorani* in sailing trim (Hawkins 1982) is 0.8. The *patorani* is relatively low in the stern. *Perahu pinis* that still have a *lapara* aft hidden under the *ambeng* are high sterned.

Ratios of length, beam and depth. The essential proportions of a hull are length, beam and moulded depth or "depth in the hold". These proportions cannot be measured from drawings or photographs. Measurements taken from any model except an accurate scale model would be very suspect.

Quite probably *perahu padewakang* were regularly measured for tonnage which would require measurement of length, beam and depth but if any records exist they are not available. A survey entitled *Boats and Boat Building in the Malay Peninsula* (Warrington Smyth 1902:577, 580) gives dimensions for a large number of *perahu* types including the *bandong (bondeng)* and the *pedewak* (Bugis, Celebes). Unfortunately the dimensions given are clearly impossible; the *bandong* is given a beam of 6 feet and a depth of 3 feet and a freeboard of 13 feet (presumably it was a type of zeppelin). The *pedewak* dimensions are given as "99ft by 15ft by 12ft; 6 ft 3 in freeboard". The length to beam ratio is thus 6.6:1 which would be narrow even for a canoe.

The *perahu patorani Sinar Galesong* has a length to beam ratio of 2.65:1 which makes her a rather beamy craft. The lines of a *perahu pajala* (Horridge 1979: Fig. 5) show a length to beam ratio of 3.65:1. The *pajala* has very little moulded depth. If her hull were given greater depth, the flare of the topsides would increase the beam, and an extra straik would bring the length to beam ratio close to 3:1.

The *perahu palari pinis Bintang Satoe,* Item **G** (Blake 1929), has a length to beam ratio of 3.04:1; measured for length from the aft side of the stem to the fore side of the stern post at *lapara* deck level and measured for beam to the outside of the planking midships.

Gibson-Hill (1950:112) gives dimensions for six *palari pinis*. The lengths given are water line length and length overall which unfortunately includes the bowsprit. However Gibson-Hill *(ibid)* says: "The men themselves measure the hull internally, taking the distance from the aft surface of the head of the stem post to the forward surface of the head of the stern post". This figure is about 6-8% more than the external waterline measurement. So, increasing the waterline lengths by 7%, an average length to beam ratio for the six *palari* can be calculated. It is 3.4:1.

A Bugis Manuscript About Praus translated and interpreted by Macknight and Mukhlis (1975) offers a number of dimensions and ratios for building a *perahu*. There are however, some difficulties with the interpretation, which is in places very confusing.

Some of the confusion arises from doubtful translation of nautical terms. For example, the term *kalibiseang* is translated as hull, but it means keel (it is more likely that the aft part of the keel rather than the hull is one hand span wide). Similarly, *panyambung* is translated as hull extension (i.e. *lapara*), but it usually means a keel extension that joins the stem, and *pa'marru* is translated as bowsprit but this should be stem or stern post.

A section dealing with length and beam is translated (1975:276): "As for the hull of the prau [it should be] two fathoms with closed fists on either side and its length twelve fathoms with closed fists". During construction the beam is measured on each side of the keel in order to keep the vessel roughly symmetrical. This is because the hull is built up as a shell of planking from the keel with no frames or formers to build around. The formula gives a neat length to beam ratio; length twelve fathoms, beam four fathoms, hence a ratio of 3:1. Unfortunately the next sentence is translated "if the width of the hull is about one fathom then its length [should be] about nine fathoms". This gives a pencil thin 9:1 length to beam ratio.

Depth. Most drawings and photographs agree with Kolff's description (Kolff 1840, quoted Horridge 1979:27) of *padewakang* as having "high sides". He goes on to describe them as "having but little hold in water" which is true of *perahu patorani, bisean* and *pajala* and is true for most *perahu bago, palari* and *pinisi* when they are in ballast. Some do have much greater depth of hold in the water by virtue of having more deadrise.

A *perahu patorani* is usually trimmed so that her freeboard midships is a slightly greater measurement than her draught. The measured drawing of *Bintang Satoe* (Item G) shows lightly more freeboard midships than draught. The photograph of a beached *padewakang* at Alor (Item E) shows similar proportions, as do the beached *perahu* shown in item **I**. If one assumes that a *padewakang* will generally show slightly more freeboard midships than she has draught, then an approximate depth as a proportion of length can be calculated. This produces the following figures:

A: 0.096	H: 0.094
B: 0.098	I: 0.109
C: Model (0.16)	J: 0.109
D: Model (0.16)	K: — (deep laden)
E: 0.097	L: 0.095
F: 0.111	M: — (model)
G: 0.107	

These figures show remarkably little variation although some are measured from photographs that are not true profiles and others are from rudimentary sketches. The lack of allometric variation in freeboard is surprising. The average figure is 0.10 and the figure for a *patorani* is almost exactly the same.

Sinar Galesong has a depth midships measured from the upper surface of the keel to the level of the rail of 1.5 meters of which 0.885 metres is freeboard. The ratio of depth to freeboard is 1.7:1. For *Bintang Satoe* the ratio is 1.79:1 measured to the rail (the normal convention is to measure to the underside of the deck of a vessel that has a permanent deck). Interpolating these figures, an approximate ratio of 1.75:1 for depth to freeboard is suggested. A vessel 15 meters in length would have a freeboard midships of 1.5 meters and a depth of 2.625 metres measured to the height of the rail. This is fairly deep and high-sided for a vessel with little deadrise. Without adequate beam or a considerable amount of ballast such a vessel would be unstable. Too narrow a vessel can capsize unless heavily ballasted as illustrated in Figure 6.

It seems unlikely that *padewakang* would carry more than two or three tons of ballast, and most *perahu* built in recent times are designed to sail with a fairly small amount of ballast relative to their tonnage. Ballast is normally discharged before loading a cargo and it is also usual to discharge ballast before beaching. Re-ballasting is an arduous and time consuming business, particularly in ports like Ujung Pandang where coral collected from the reef is often the only ballast available.

A vessel's ratio of beam to depth should be adequate to give it reasonable stability with a moderate amount of ballast. A *padewakang* would have had fairly light upper work, and the upper planks were apparently often made of lighter timber (Macknight and Mukhlis 1975: 279). *Bintangor (Callophyllum blancio)* is such a timber and is frequently used. The bamboo and thatch cabins would be light and so would the spars. The large matting sails, on the other hand, would have become extremely heavy when exposed to rain water. This is exemplified by the large salt carrying *perahu* of Kuala Trengganu in east coast peninsular Malaysia which, until a few years ago, were still carrying matting sails. When wet, their sails became so heavy that some vessels could not carry full sail even in a light breeze if there was drenching rain. Those *perahu* normally retained 20-25% of their salt cargo as ballast.

The beam to depth ratio of *Sinar Galesong* is 2.39:1; that of *Bintang Satoe* is 1.75:1. An 18th century American vessel with the same ratio as *Bintang Satoe* is described by Chap-

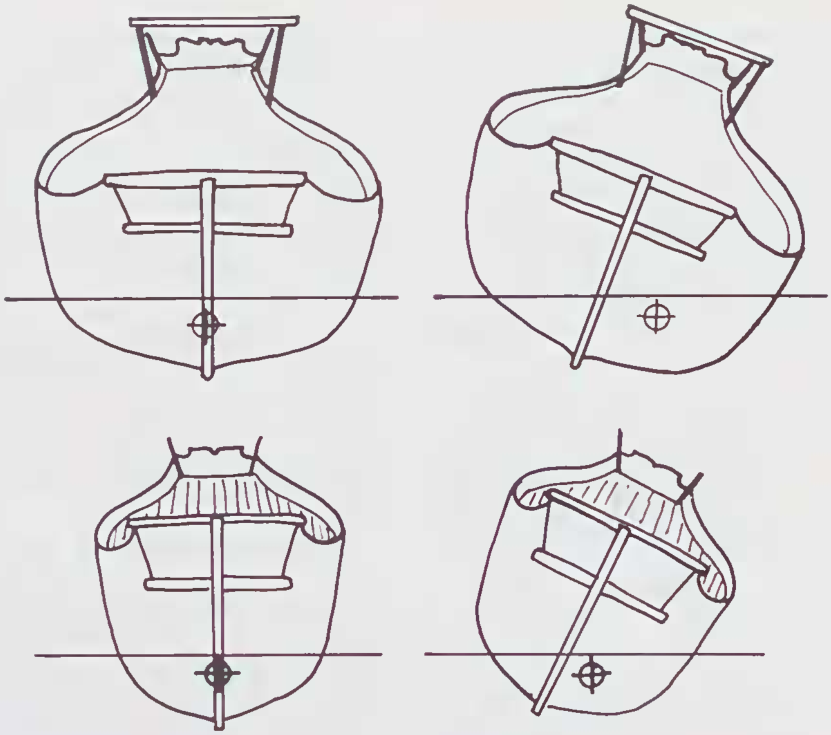

Fig. 6. Vessel heeling seen from the bow. When the vessel heels the centre of bouyancy is displaced to the lowered side and produces righting moment. The narrow vessel has less stability.

pele (1967:189) who comments: "Such a vessel would need ballast when sailing light, and unless properly loaded, had a tendency to sail with an uncomfortable angle of heel".

Similarly, a survey of late 18th century European vessels of approximately *padewakang* size (between about 12 metres and 20 metres long), plans of which appear in *Merchant Sailing Ships 1775-1815* (MacGregor 1980), produces an average beam to depth ratio of 1.85 (the range of figures is between 1.64 and 2.0).

So if we select a beam to depth ratio for the *padewakang* of, for instance 1.9:1, we can then calculate all the major hull dimensions as a proportion of the hull's length, as shown below:

Length =	*15 meters*
Length :	Freeboard ratio 10 : 1
Freeboard =	*1.5m*
Freeboard :	Depth ratio 1 : 1.75
Depth =	*2.625m*
Depth :	Beam ratio 1 : 1.9
Beam =	*4.9875m*
Length :	Beam ratio 3 : 1

Thwartship measurements such as beam at the *selompeng* can be calculated as a proportion of the midsection beam. Thus, the beam at the top of the forward *selompeng* as a proportion of the maximum beam is:

Sinar Galesong: 0.49
Bintang Satoe: 0.50

In both cases there is no *selompeng* aft but the beam at the aft edge of the *sangkilang* can be measured, with the following results:

Sinar Galesong: 0.50
Bintang Satoe: 0.54

It should be noted, however, that this measurement for *Bintang Satoe* may be inaccurate because the *sangkilang* goes not appear on the body plan or the half beam plan in Blake's drawings.

Hull form below the water line.

(a) The Midsection: Perahu are built without plans and with no frames set up to indicate the mid-section or any other section. The form of the midsection can be described or prescribed in terms of deadrise, hardness or slackness of the bilge, and flare of the topsides. These qualities are described in relative terms. Deadrise is not given as an angle but described relative to an understood local norm. Deadrise could be "absent", "nearly absent", "a little", "reasonable", "fast", etc

("tidak ada", "hampir tidak ada", "sedikit", "sedang", "cepat", etc.).

Sinar Galesong has about 7° deadrise, although it is difficult to estimate because the planking is not fair and the turn of the bilge starts very close to the keel. *Bintang Satoe,* on the other hand, has about 15° deadrise. By comparison a *pajala* (Horridge 1979:6) has only about 5°.

It seems reasonable that *Bintang Satoe,* a larger vessel employed on longer voyages would have slightly greater deadrise. This should confer slightly greater lateral resistance and potentially slightly better windward performance. *Palari* like *Bintang Satoe* were not weatherly craft; they made their longest voyages with a following trade wind although they also made voyages of two or three hundred miles eastwards along the Lesser Sunda Archipelago against the south-east trade winds (Gibson-Hill 1950:111; Collins 1936: abstract log in appendix).

The hardness or slackness of the bilge is described in terms of the number of straiks fitted before the planking must start to curve up through the turn of the bilge (*"berapa papan bangun"*). This depends on the width of the planks used which varies regionally and sometimes according to the size of the vessel.

Sinar Galesong with a slack bilge is only one or two *papan bangun. Bintang Satoe,* with a somewhat harder turn to the bilge, is four or five *papan bangun.* A modern *perahu lambo* of similar length would normally be at least seven or eight *papan bangun.*

(b) Rocker: Rocker is the curving up towards the ends of the keel. Not all vessels have rocker, some in fact have the opposite, which is called drag.

The keel (*lunas*) is usually made up of three pieces of timber the keel proper (*kalebiseang* in *bahasa Makassar*) and an extension at each end (*penyambung*) that usually curve up into the stem and stern post (*pemaru*) (refer Fig. 7). In modern building practice, the *kalebiseang* can be straight but often it shows a little rocker. With the *penyambung* added, the keel usually shows considerable rocker especially forward. *A Bugis Manuscript about Praus* (Macknight and Mukhlis 1975: 274) seems to offer contrary advice, for the translation reads: "As for the extension, it is made flat in front, although [there is] only one pump [and] hatch." The relevance of the information about the pump (or bailing hatch?) is probably that a vessel with a flat keel, having no rocker would have no low point in the bilge where water would collect and from whence it might be bailed. The result would be bilge water lying all along the length of the keel, and if there were no limbers in the floors to allow drainage, or if (as is normal) the limbers were blocked with grot, then she would need bailing or pumping from several points.

Bintang Satoe is an example of a vessel with no rocker in the keel. However, she was originally from Bau Bau, on the island of Buton, where boat building practices are not now identical to those in South Sulawesi. Modern hull forms with straight keels (*perahu lambo*) are currently much more common on Buton and in its surrounding areas than in South Sulawesi.

The 19th century models all show very considerable rocker right through the length of the keel, and rocker is now normal in most types of South Sulawesi perahu, even the large *perahu pinis.* Thus, *Sinar Galesong* has rocker right through the length of her keel, and a suitably scaled drawing of *Sinar Galesong* can be super-imposed on the photograph of a *padewakang* (Item **E**) to show that the rocker is virtually identical.

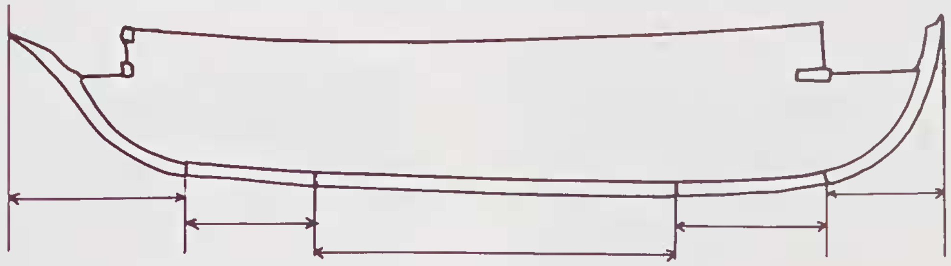

Fig. 7. The keel with keel extensions *(penyambung)* and the stem and stern post.

A set of conjectural lines for a 15 meter *perahu* were drawn using the foregoing analysis to modify the lines of *Sinar Galesong*. Using these lines a plank on frame model was constructed. The model was taken to South Sulawesi in 1986 by historian Peter Spillett where it was discussed with boat builders. Particularly fruitful discussions were had between Pak Rustam, Mr Spillett and the author. Some modifications of the hull form were suggested and these will be discussed later.

Construction of the Hull. In modern 20th century South Sulawesi boat-building, keels are sometimes a single timber without *penyambung* extensions, but this is regarded as a non-traditional practice. *Perahu patorani* are constructed with a keel made up of three timbers. The method of calculating the lengths of these pieces was described by a boat builder (personal communication, Sulawesi, 1986) from Lemo Lemo, who was at that time building a *patorani* at Galesong. He explained that all the measurements are based on an arbitary length called *ruang*, which is often the hand span (*jengkel*) of the builder. The length of each section of the keel is a multiple of this *ruang*, which must be an odd number. When the keel timbers are fashioned, the *ruang* are marked on the upper face of the keel. Alternate *ruang* are left slightly raised and are refered to as *tambugu* or *tembugu*. The *ruang* and *tambugu* (or *tembuku*) persist from an ancient lashed rib construction. Ribs were fastened by lashings to projecting nodes called *buku*, hence *tembuku* presumably from *tempat buku* (*bahasa Indonesia*) meaning place of the *buku*. *Ruang* simply means space in *bahasa Indonesia*. For a full discussion of this development the reader is referred to Horridge (1979).

Joins between sections of the keel must be at the point between *ruang* and *tambugu*. Typically a *patorani* keel would have its middle piece with three *ruang* and four *tambugu* while the extensions would have four *ruang* and three *tambugu*. The ends of the stem and stern post joining the keel would each have one *ruang* and three *tambugu*. This would make the three pieces of the keel the same length if *ruang* were equal. In fact one *ruang* just aft of midships is longer than the others because later it has a hole drilled through it as the vessel's navel (*pussi*). There seemed to be some variation of *ruang* because although the builder said all other *ruang* and *tambugu* were equal, he also stated that the aft *penyambung* was the longest part of the keel and the forward one the shortest.

Rib placement and spacing. In the construction of a *perahu* the shell of planking is built up first, straik by straik, and the ribs are fitted later. In traditional construction even the planks are grown timbers; they are selected with natural curves so the hull can be built as a shell with the planks edge-dowelled together.

Although the planking is assembled before the ribs are fitted, it is necessary for the builder to mark the positions of the frames on the keel before the planking can be started. This is because the scarfs in the planking must be backed by a rib and must be correctly staggered according to a strict planking pattern.

The position and spacing of the ribs is given by the *ruang* and *tambugu*. At each *tambugu*, a "floor" (*kilu*) crosses the keel. This floor is part of a complete frame or rib with bilge futtocks (*solor*) and top pieces (*taju*). Alternating with these frames and aligned with each *ruang* are frames comprising of first or bilge futtocks (**solor**) which start two or three straiks from the keel and connect with top pieces (*taju*).

In many smaller types of *perahu* — for example, South Sulawesi *pajala* and *patorani*, Ende (Flores) *soppe* and *jukut*, Paloe (off Flores) *palari* and Kangean Islands (off Java) *mayang* and *lete* — the floors span the whole bilge and do not connect with futtocks. The floors are alternated with frames comprised of either a single grown timber on each side, or a bilge futtock (*solor*) that starts two or three straiks out from the keel on each side, runs through the turn of the bilge and then connects with a top futtock (*taju*) (Fig. 8). The *taju* often project above the sheer straik to form stanchions. Boat builders say this arrangement is not appropriate for larger vessels which must have full frames with spacing of about 300 mm between centers.

The Plank Pattern. All planks are edge dowelled together. The dowels are usually at 200mm (one hand span) intervals in modern construction. The garboard straik (*penyepe*) is dowelled to the keel and because it is longer than the middle section of the keel it locks the sections of the keel together (fig

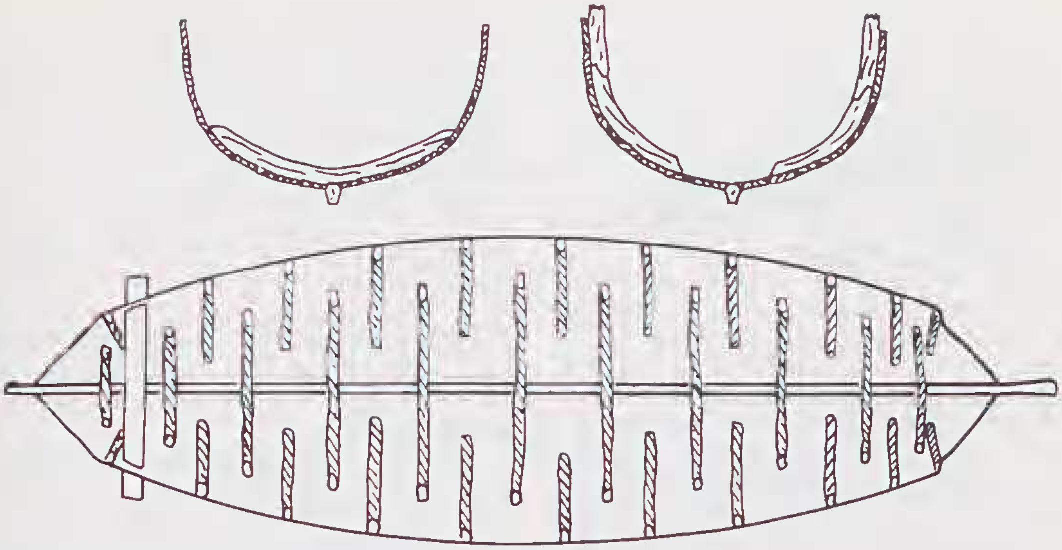

Fig. 8 An arrangement of rib spacing with alternating floors and bilge futtocks.

18). The stem and stern post are similarly locked on by unusual shaped planks at the ends of either the second or third straik depending on the size of the vessel.

COMMENTS ON TRADITIONAL FORMS OF DECK, SUPERSTRUCTURE AND RIG

Ambeng. The stern gallery or back verandah of South Sulawesi *perahu* is built on a number of projecting beams laid across the low aft deck. There seems to have been considerable variation and development in the form of this gallery, usually called *ambeng* or *ambing*, during the 19th century.

William Westall's drawings (Items **A** and *B*), made in the first decade of the 19th century, show vessels that either have no *ambeng* or have only a rudimentary platform *ambeng*.

The Rotterdam model (Item **C**), from the middle of the century, has a fine high *ambeng* structure with panel work and carved balustrades. It seems to be built in imitation of a European vessel's decorated stern, but such sterns were an anachronism in the west by the mid 19th century. The main *ambeng* structure is inside the stern post. The roof of the *ambeng* forms an upper deck which is extended aft outboard over the stern post as a second *ambeng*.

Mid-century examples, Items **F** and **J**, show *ambeng* with no upper *ambeng* extended aft.

The model dated circa 1880 (Item **D**) has an exaggerated, long and heavy *ambeng* of the double *ambeng* type. Unusually, it lacks an opening in the side from which the helmsmen could reach the rudders or tillers. This model shows a development from the earlier form of double and single *ambeng*, in

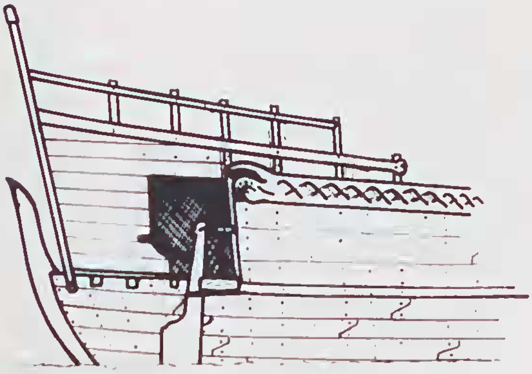

Fig. 9. Early style of *ambeng* built inside the stern post.

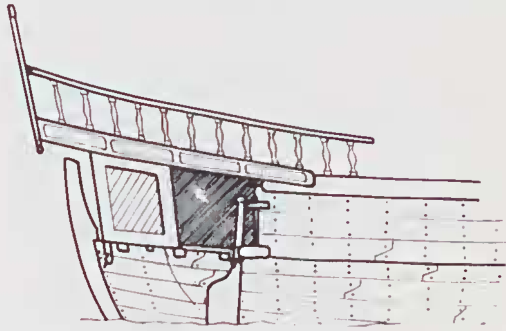

Fig. 10. Double *ambeng*.

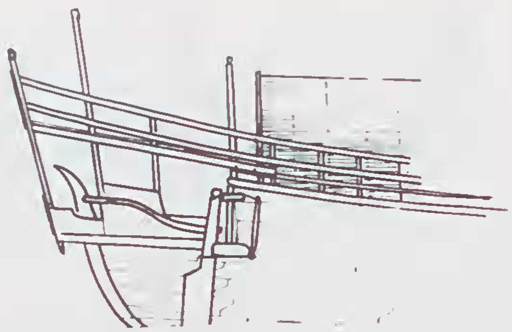

Fig. 11. Double *ambeng* with the lower *ambeng* extended aft of the stern post.

that its *ambeng* is a continuation of the lines of the topsides and does not interrupt the sheer.

The details of the *ambeng* in the photograph Item **E** are not all clear. Certainly it is a double *ambeng*. The sides and rail of the *ambeng* are formed by large finely carved planks that probably cover the projecting ends of upper deck beams. Very similar planks are seen on the late 19th century model used as an illustration in Matthes' Bugis dictionary (1885) and shown in Horridge (1979: Figs 22 and 23).

Bintang Satoe, built about 1900 has a double *ambeng* with an extended lower *ambeng.* There is a transom inside the stern post but the *ambeng* is continued aft past the post. This extension separated from the rest of the vessel by a transom might have been the "heads". The mid 20th century drawing, Item **H**, shows a similar arrangement. This form of double *ambeng* is still occasionally encountered on old *perahu palari*. In some cases the tillers reach back to the extension of the lower *ambeng* and the helmsman steers from there (for example as shown in Item **K**) but this is not always the case.

The *ambeng* that developed during the 19th century seems to have started as a simple box-like house on the stern of the vessel that was contained within the stern post (Fig. 9). The *ambeng* roof became an extension of the upper deck or spar deck and was extended aft over the stern post to form the second *ambeng* of the *ambeng dua kali* or double *ambeng* (Fig. 10). The *ambeng* then became moulded into the lines of the topsides and the sheer (**G** and **H**) and the lower *ambeng* gained an extension taking it outside the stern post (Fig. 11).

The Deck. There seem to have been a number of different deck arrangements used on *padewakang*. The vessels in the trepang fleet described by Searcy (1905:16) did not have proper planked decks: "The deck is of split bamboo worked together with wire or fibre and can be rolled up at pleasure". Obviously split bamboo decking could not be waterproof. Probably vessels decked in this manner had a roof over most of the hold and right up to the rail so that the cargo would not be spoiled by rain water. This arrangement is still very common on several types of medium-sized *perahu* including the modern *perahu lambo*.

The padewakang on which Alfred Russel Wallace sailed to the Aru Islands in 1856 had a planked deck which projected outboard by two or three feet amidships. There was a thatched house on deck which had a bamboo slat floor that was "raised six inches above the deck, so as to be quite dry" (Wallace 1869:370). Some models show the deck projecting outboard, and this would be a simple way of preventing water from leaking into the hold from the seam between the deck and the rail. The projecting deck and deck beam ends were hidden by a large plank which was sometimes carved as in the photograph, Item **E**, and the Leiden model illustrated in Horridge (1979: 28, Figs 22, 23).

The western style of deck that does not project outboard was also used, as displayed in Item **D** and **G**.

Decks are generally considered to be a modern development in Indonesian *perahu* (Horridge 1979: 24-30). The common use of the loan word *dek* is cited as evidence of this. The use of large flush decks certainly seems a recent development. There are, however, indigenous words meaning deck such as *katabang* in *bahasa Bugis*.

The Rig. All *padewakang* carried a large tilted rectangular mainsail. Western terminology has no name for these sails. They are not true lugsails because the halliard is rove from the forward side of the mast with the fall leading aft so that when changing tack the vessel turns downwind and the sail can be gybed over and inverted in front of the mast like a latteen or settee sail. In *bahasa Makassar* and *Bugis,* these sails are called *tanja* sail.

The *tanja* sail is set from a tripod mast stepped in tabernacles. Some *padewakang* seem to have carried a single mast while others were two-masted or occasionally three-masted. The mainmast was always furthest forward. Standing gaffs were sometimes carried particularly on the aft mast. One or more jibs could be set flying (with no stay) from a long bowsprit or jib boom.

The relative proportions of the rig can be assessed from the drawings and photographs. Mast heights were calculated as a proportion of hull length (height measured above sheer):

A: 0.83/0.7*	G: 0.71 (lower mast of early pinis rig)
B: 0.61	H: Pinis rig
C: 0.58	I: No mast
D: 0.73	J: 0.56
E: No mast	K: 0.8
F: 0.64	L: No mast
	M: 0.66

*The second figure is measured to an imaginary truck just above the tanja spar because it is very unusual to have the mast project far above the spar in the way drawn by Westall.

The average figure is 0.68. The average for a *perahu patorani* is about 0.8. Possibly the mast height as a proportion of hull length is modified by the length to beam ratio so that a beamy vessel like the *patorani* carries a taller rig.

Mast placement. Calculations of the distance from the bow of the aft spars of the tripod mast as a proportion of hull length gave the following results:

A: 0.32	H: pinis ketch rig (0.26)
B: 0.32	I: No mast
C: 0.32	J: 0.35
D: 0.35	K: 0.32
E: 0.34	L: 0.30 (?)
F: 0.34	M: 0.32
G: 0.31	

The average is 0.33 or one third. The range of figures is very small and the figure for the *patorani* is the same.

Number of masts. Fifty percent of the *tanja* rigged examples appear single masted. Wallace (1869: 311) described the vessel he sailed on as having two masts; however he drew her at anchor with only one mast stepped. On modern *perahu patorani*, the mizzen mast is a standard part of the rig but it has no permanent tabernacle and it is frequently unstepped. The *tanja* sail that is carried on the mizzen mast is carried on the main in heavy weather when the large mainsail cannot be carried.

There are three drawings showing two *tanja* sails set on one mast: Item **J**, the watercolour by Owen Stanley; and 2 drawings by P.O. King and Le Breton reproduced in Macknight (1976: Figs 2,33). The details of this arrangement are puzzling. If the mast was a tripod, both halliards would have to be led to the mast head and the lower sail would then set rather poorly. The lower sail would have to be lowered and cleared out of the way before changing tack. The drawings are little help. Owen Stanley seems to have invented all sorts of superfluous rigging and King shows little detail, but the sails seem to be set like western square sails controlled by braces.

Perhaps the artists were drawing vessels that they saw carrying two sails on two masts but were later seen with only one mast stepped when they were at anchor. Alternatively, perhaps a smaller heavy weather mainsail was carried under the mainsail in light weather if no maneouvering was necessary (see Fig. 12). Another possibility is that a single sail was made in two panels and joined with a bamboo spar in the middle or bunt rather like the multipanelled Chinese lugsail. Other possibilities exist. For example some modern perahu lete lete carry a mizzen sail but they have no mizzen mast; the spar of the mizzen sail is suspended like a sprit by a jack stay to the main mast and stayed down aft. The same sail is set from the main mast in heavy weather.

Mast Construction: Timber or Bamboo? Modern *perahu patorani* have bamboo tripod masts constructed of a very strong type of bamboo from Pulau .Selayar called *bambu patung*. Sometimes the forward leg of the tripod is timber. Larger 20th century South Sulawesi *perahu* have timber masts. Tripod timber masts still exist while bipod and single pole masts are also used. Tabernacle stepped masts are still common.

Probably a *perahu padewakang* could have been fitted with either timber or bamboo masts. There are reasons to suppose that timber masts were in use. *Perahu padewakang* often carried gaff sails, particularly on the mizzen. These must have been rigged as a standing gaffs because it is not possible to hoist or lower a gaff on a tripod mast. It seems likely that in this case the mast would have been timber because it is difficult

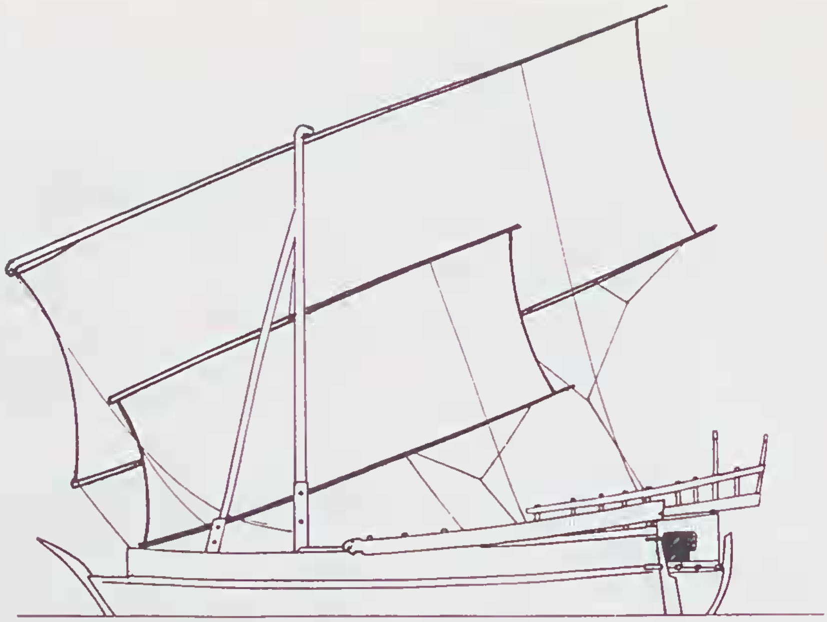

Fig. 12 Two *tanja* sails carried on one mast.

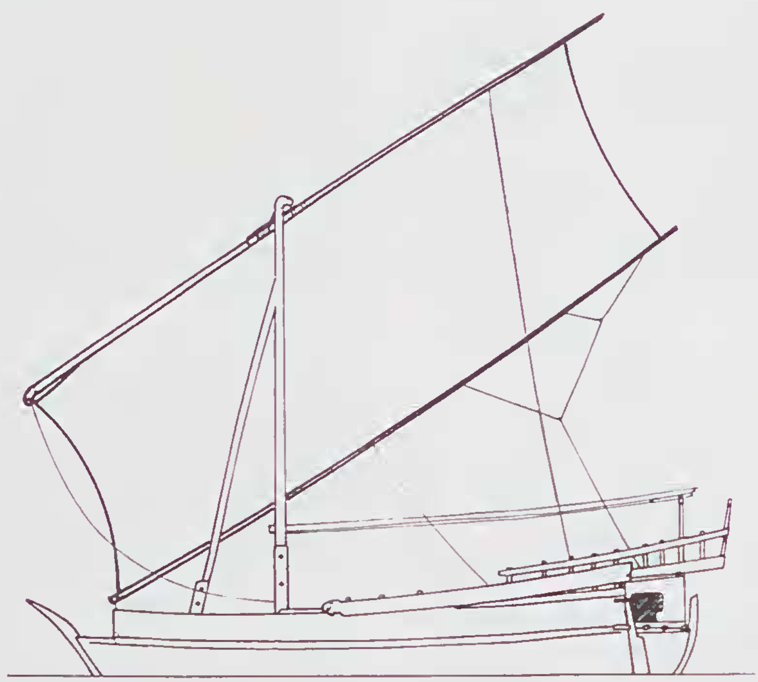

Fig. 13 Narrow *tanja* sail set with the tack hauled down to the *selompeng*.

to accommodate the jaws of a gaff on a bamboo tripod mast of the South Sulawesi type.

Early in this century the rig of the *padewakang* or *palari* was westernised or modernised. The traditional *tanja* sails were replaced with large standing gaff sails with jib headed topsails and headsails set on standing head stays. This transformation required the use of wire standing rigging, strong trestletrees and crosstrees, and the cap necessary for doubling a top mast. Such an arrangement necessarily used heavy timber masts. The tripod configuration was retained although the mast could no longer be easily lowered

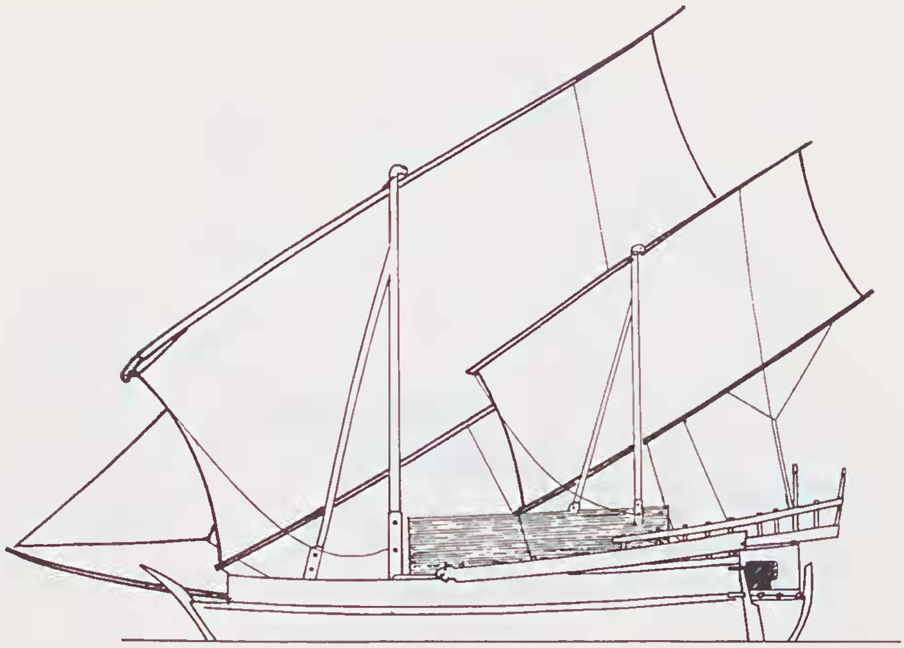

Fig. 14. Two masted rig.

and depended on standing rigging for its support. If the change to the modern *pinis* rig had entailed a change in mast material and mast building technology, then perhaps the redundant tripod mast might have been abandoned at the same time.

Proportions of the *layar tanja*. The proportions of a sail can normally be discussed in terms of aspect ratio; the ratio of height to breadth. The aspect ratio of a *tanja* rig varies according to the angle at which the sail is inclined. An equivalent of aspect ratio that will remain constant is the ratio of length along the spar and boom to the depth between spar and boom. It is effectively opposite to aspect ratio because a higher length depth ratio produces a lower aspect ratio. Only six of the examples can be measured in this way, as shown below:

B: 3.30	J: 2.65 (2 sails)
C: 3.44	K: 2.78
D: 3.03	M: 2.98

The average is 3.03.

For a patorani the figure is about 2.35: the sail is deeper because it is set from a taller mast. In most cases the spar is very long. On a patorani the spar is slightly longer than the hull — this proportion is very constant in the drawings and models (except Item C which is a three master). The proportion is also confirmed by Wallace (1869: 311).

An apparent difference between the 19th century rig and the modern layar tanja is the relatively long narrow sail of the 19th century. It is set on a somewhat shorter mast but the mast is not shorter by as great a proportion as the sail is narrower. The result is that the sail would seem to be set at a slightly higher angle when the tack is hauled down to the top of the selompeng (see Fig. 13). The sail is almost invariably set with the tack hauled down in this way in modern practice. Several 19th century drawings show layar tanja set with the tack well above the selompeng and in some cases well aft of the selompeng.

Either the technique of setting the sail has changed or the drawings reveal some confusion about the way the sails were set. If a long narrow sail was set fairly horizontal then it would be possible to set a smaller *tanja* sail under it with a separate halliard in the manner suggested by Le Breton's drawing and illustrated in Figure 12. This smaller sail would be the sail set in heavy weather. It would be necessary to drop this sail before changing tacks and it would be extremely awkward to get it around the mast to be set on the new tack.

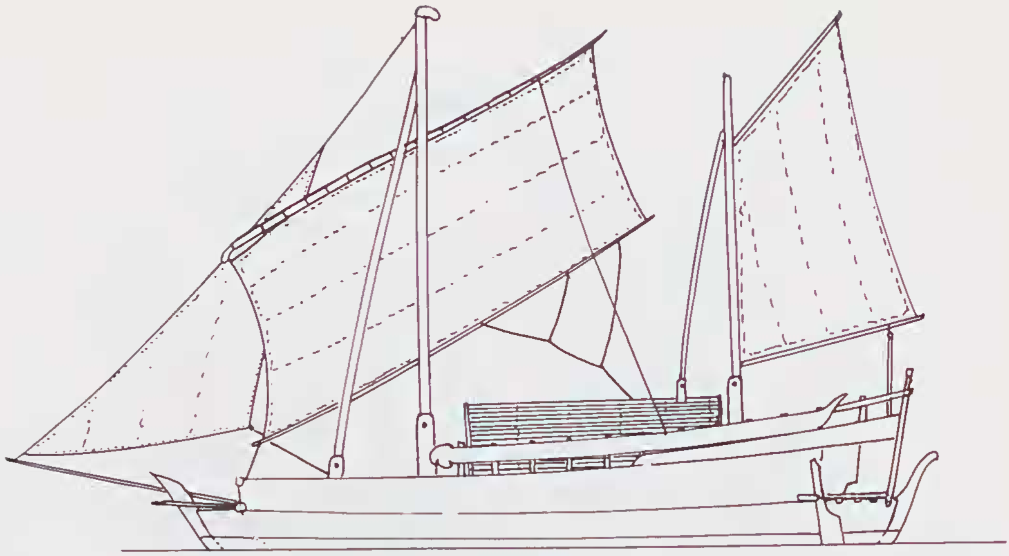

Fig. 15. An arrangement of reduced sail area for squally conditions.

COMMENTS AND SUGGESTIONS FROM 20th CENTURY SOUTH SULAWESI BOATBUILDERS

A planked model was constructed using the lines shown here in Figure 17. The model was shown to Rustam A.M. (the builder selected to build a full-size replica 19th century *perahu* for the Australian Bicentennial Celebration project cited earlier) by project officer Peter Spillet.

Rustam felt that the beam and depth were too great relative to length. The projected proportions were 15m L.O.A. x 5m extreme beam X 2.5m approx depth from sheer to keel midships. Rustam wanted to build a vessel with 4 metre beam and less than 2 metres depth.

The author was asked to go to South Sulawesi to confer with Rustam about this difference. *En route*, at the town of Bima on Sumbawa (which was formerly part of the territory of South Sulawesi's coastal sultanates), opinions about relative proportions were sought from builders, owners and sailors of traditional South Sulawesi *perahu*.

In Bima harbour at that time there were four *perahu palari/bago*: a type of vessel with an old, traditional hull form and a modern sloop rig. The two larger *palari* were from Pulau Sabalana in the Pulau Pulau Tengah group. One of them was unladen so it was possible to inspect her construction and hull form. This vessel was *Sinar Negara II*, owned and captained by Haji Samasuding. She was built in 1978 by *tukang Ara* (noted traditional boat-builders from Ara in South Sulawesi). All timbers were *aju bitti (Vitex pubescens)*, the timber of choice in South Sulawesi. The hull form showed a very heavy and bluff entry and run; the construction was very old fashioned with no sawn timbers used even in planking; and there was no apron on the stem or stern-post.

Her length was 12.5 metres, her beam a full 5 metres, and her depth in the hold approximately 2 metres measured to the sheer, or approximately 2.5 metres measured to the height of her sloping side decks.

Haji Samasuding laughed at the idea of building a 15 metre sailing vessel with only 4 meter beam. He suggested that such a proposal might be fraudulent in intent because such a vessel would necessarily be low and light and very cheap to construct.

On the western shore of Bima harbour there are a number of villages where traditional types of boat are built. Until recently some were still rigged with traditional tanja sails, in which case they were called waka. Nearly all are now sloop rigged and most have been given decks and deck house so they resemble South Sulawesi perahu palari. They are usually called lopi, and lopi means boat in Bugis.

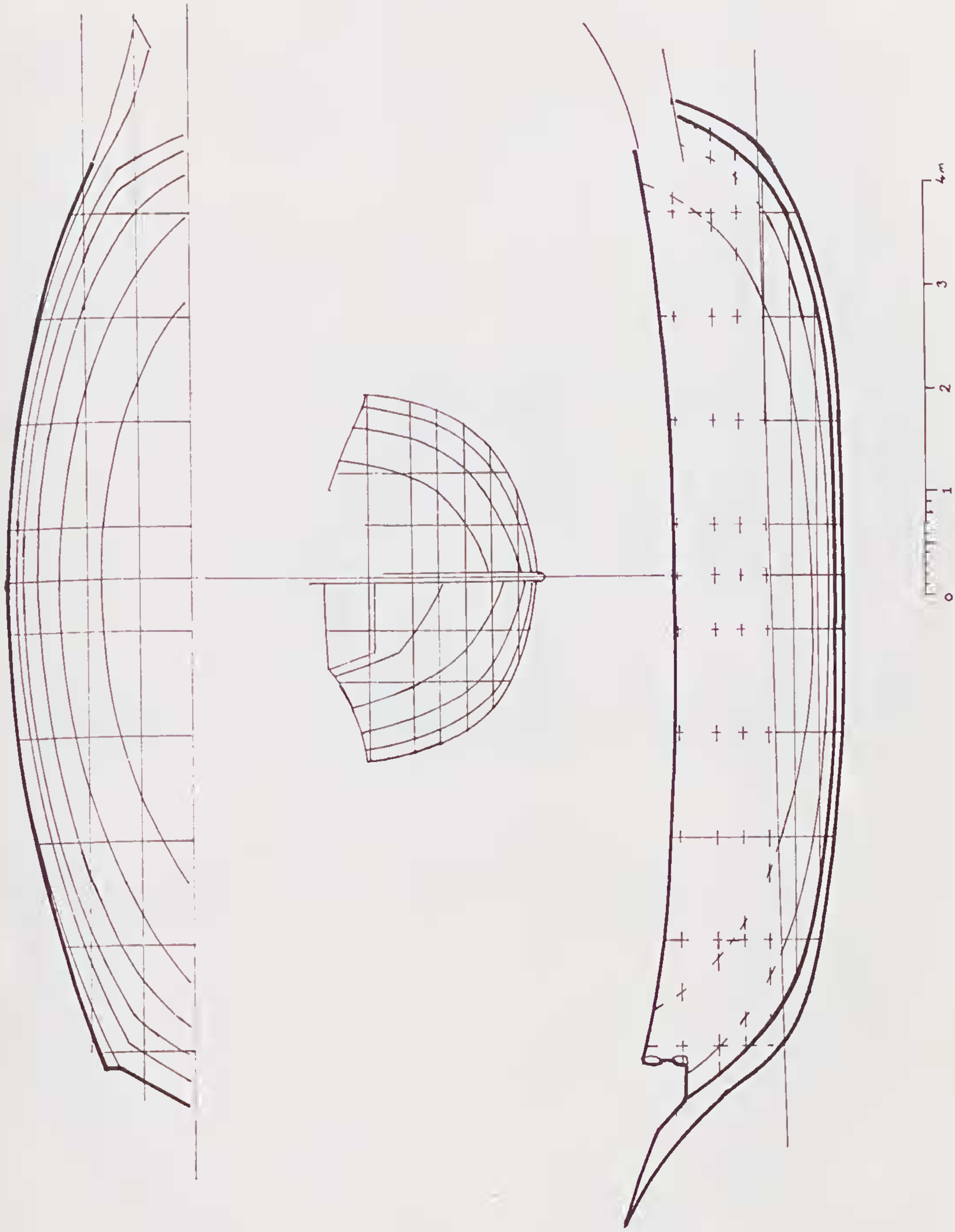

Fig. 16. The lines of the *perahu patorani Sinar Galesong.*

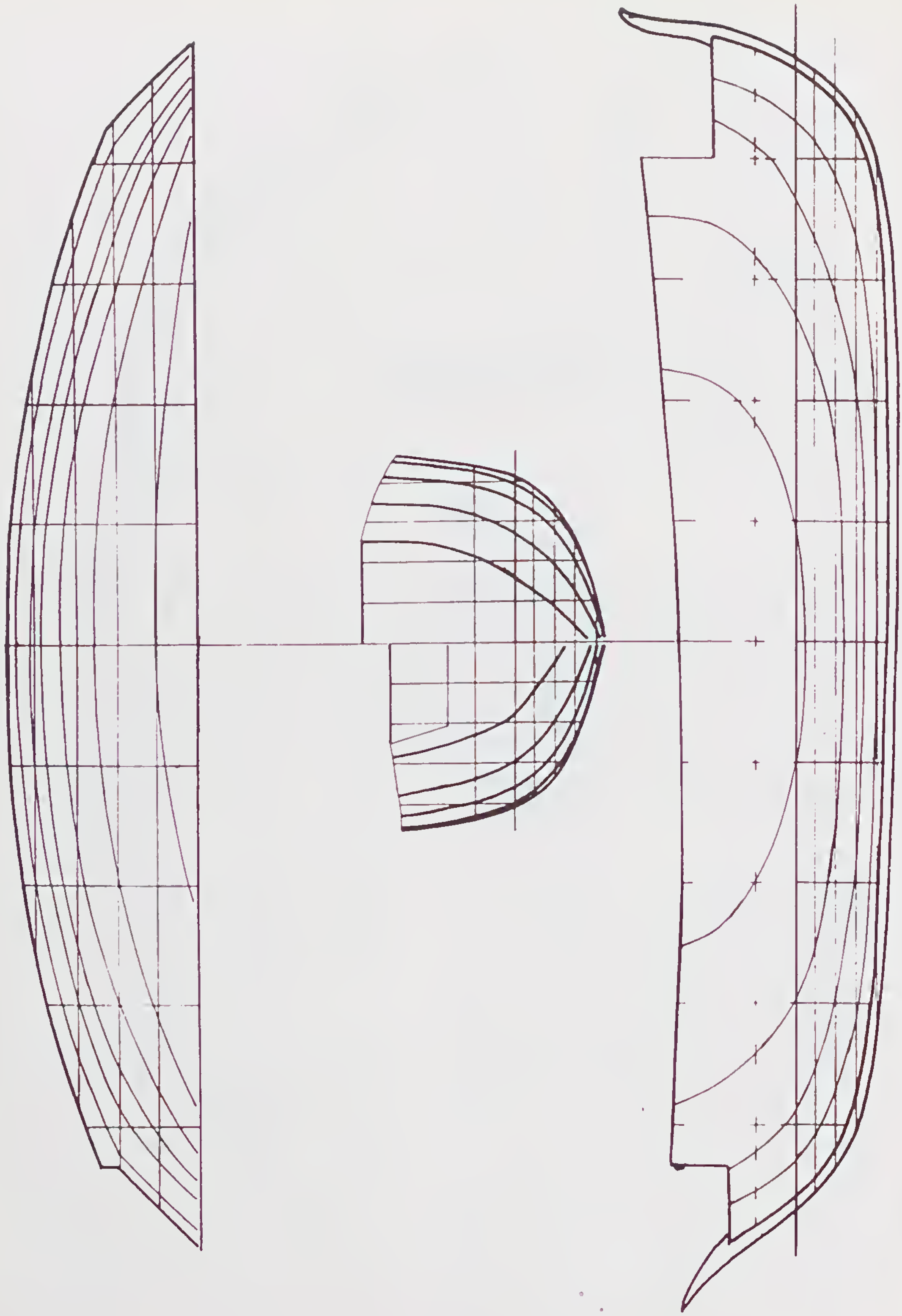

Fig. 17. Conjectural lines for a *perahu padewakang*.

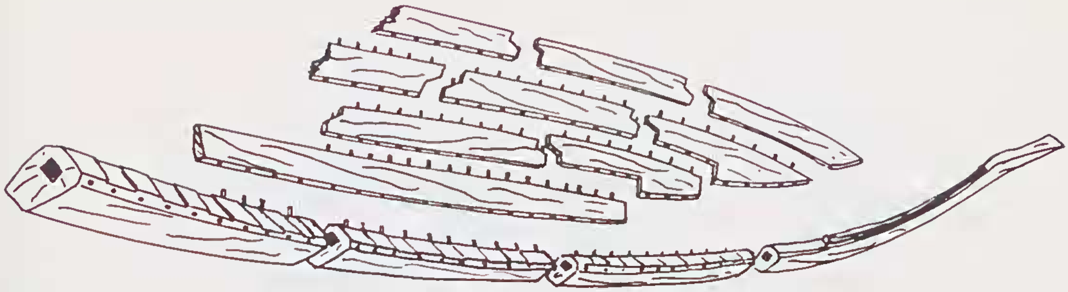

Fig. 18. Keel and planking assembly; the edge dowelled planks lock the keel assembly together.

Most *lopi* are employed for carrying salt from salt flats at the southern end of the harbour to anchorages around Bima where it is loaded on to larger inter-island *perahu*. *Lopi* are also sometimes engaged in short-haul inter-island trade. When carrying salt to the outer harbour they are obliged to beat back empty and with no ballast. They do not beat well but they are stable enough to beat in a 15-20 knot breeze with no ballast in sheltered water.

Four *lopi* were under construction at a village called Daru. The builders said that 3:1 was the correct ratio of length to beam but most *lopi* were given more beam out of regard for capacity and stability.

In Ujung Pandang, South Sulawesi, Rustam the boat builder agreed that a vessel of 15 meter length would normally have 5 meters or more beam. He pointed out that such a vessel would carry a very large sail. Following standard proportions for *tanja* rig the mainspar would be 17 metres long. He felt that such a sail was possible but it could be very difficult to handle, and no-one had seen or worked such a sail in living memory. In this century, vessels of 15 metre length are usually rigged as *pinisi* with a relatively manageable standing gaff ketch rig.

Rustam argued that a vessel given less beam could carry a smaller rig. Having inspected the various drawings and photographs of 19th century *perahu* used here, Rustam agreed that they did all carry large sails with very long spars, as described by Wallace:

> "The mainyard, an immense affair nearly a hundred feet long, was formed of many pieces of wood and bamboo bound together with rattan in an ingenious manner. Wallace, 1869: 311)

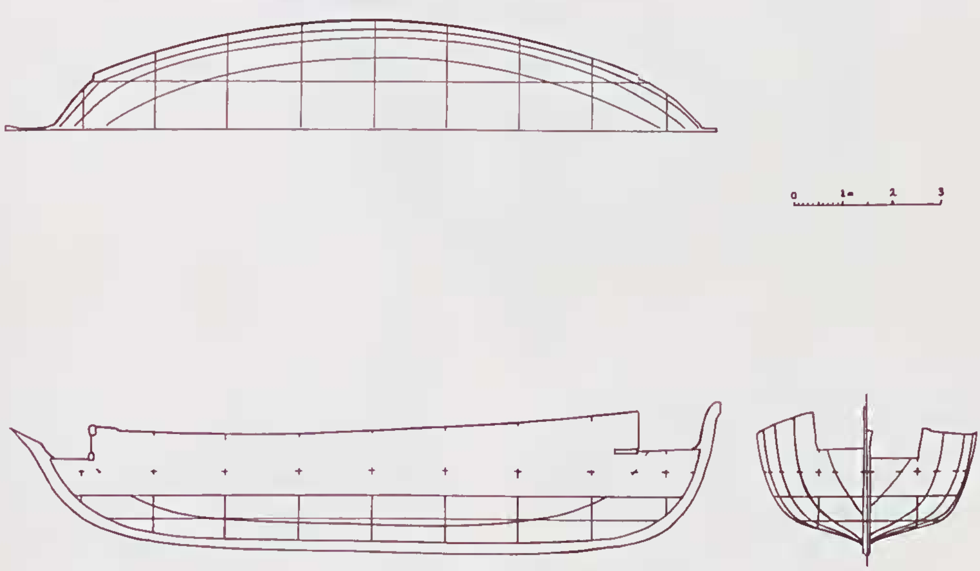

Fig. 19. Lines for a *perahu padewakang* as revised after discussion with South Sulawesi boat builders.

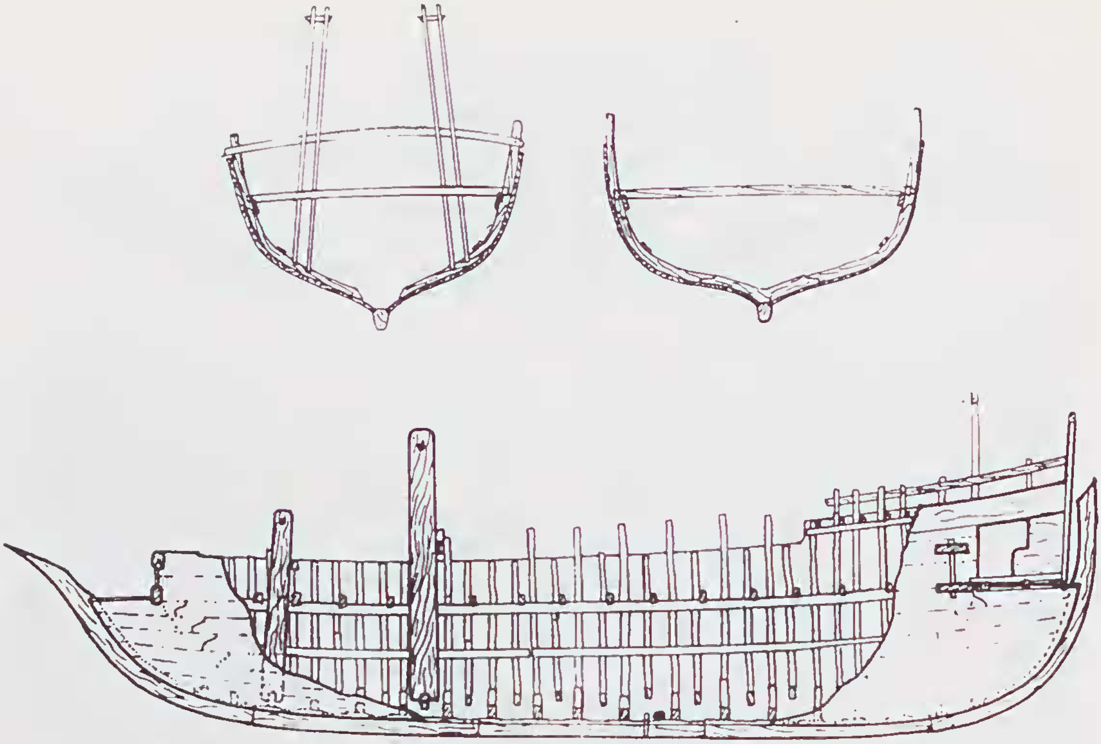

Fig. 20. Construction plans for a *perahu padewakang.*

In a further effort, photographs of the model *padewakang* were shown to *tukang Ara* building *perahu patorani* at Galesong. They quickly and confidently identified the model as built by *tukang Ara* and as representing a trading *perahu* from Sanro Bone, south of Galesong. They said it was a shallow draught design that could enter rivers to load cargo. Rustam and other builders suggested that the midships section was the midships section of a shallow draughted vessel, that it was not appropriate for a long distance trader; and was not very strong when taking ground. A more appropriate midsection would have some hollow in the deadrise *(lancap)* and perhaps a slightly harder turn to the bilge. Such a section would be structurally stronger, less prone to roll and would confer better sailing characteristics. It was also suggested that a slightly shorter vessel of 13 meters would be more easily managed.

With this information a new set of lines were drawn incorporating the modified midsection and the revised dimensions (Fig. 19).

It is not intended that the line drawings, models or sketches be used as precise plans for building a full sized reconstruction but that they should suggest the general proportions and arrangement. To this end a number of differing reconstructions were drawn and these are presented in Figures 21,22 and 23..

CONCLUSION

Definition of the 19th century *padewakang's* hull form and arrangement by using accurate planked models and comparison of the relative dimensions with those of local 20th century *perahu patorani* proved useful in that the information was sucessfully communicated to South Sulawesi boat builders and seamen. Discussion of the proposed reconstruction was conducted with great interest and attention to detail. In these discussions the boat builders and seamen gave confident and virtually unanimous statements on crucial questions including the midships section and the ratios of the dimensions. These opinions were based on long experience with their traditional sailing craft. Some of the 19th century illustrations were studied carefully by these men while other less plausible illustrations were dismissed as mistakes on the grounds that such a vessel could not be sailed.

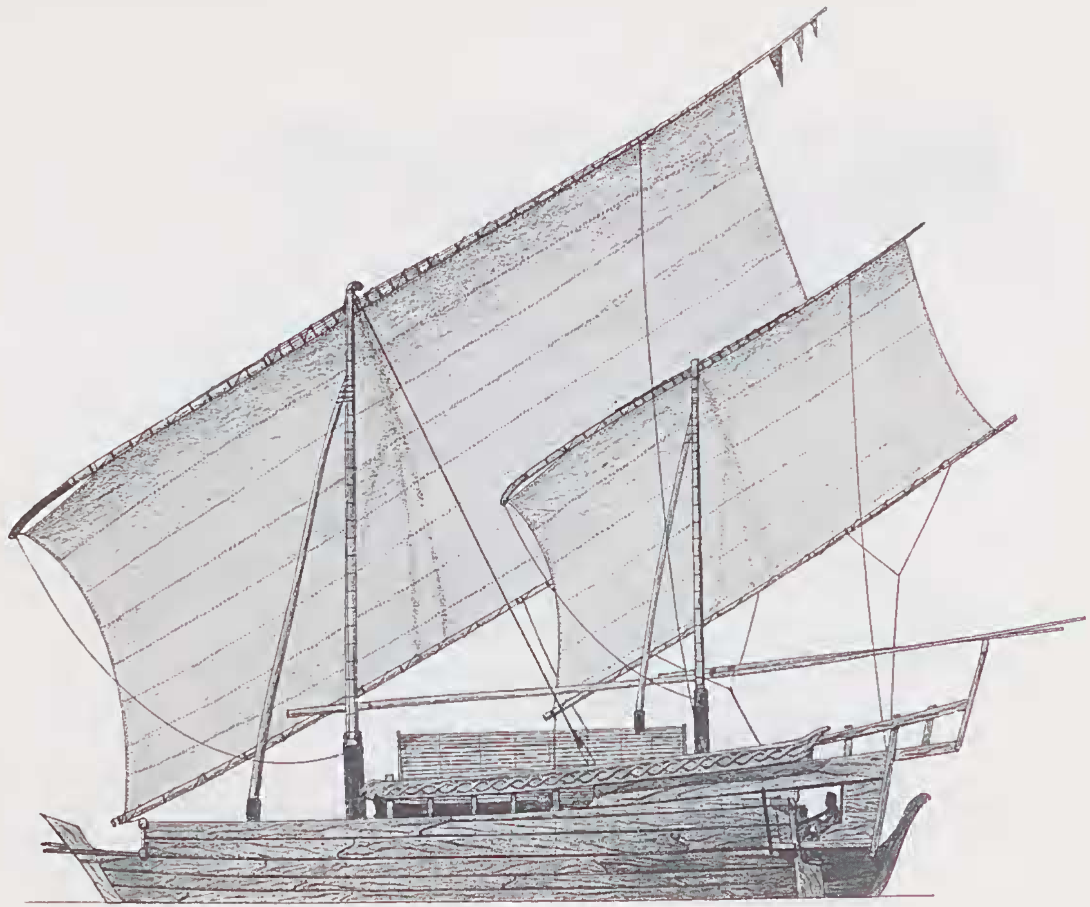

Fig. 21. Reconstructed appearance of a 19th century Makassan *perahu padewakang*.

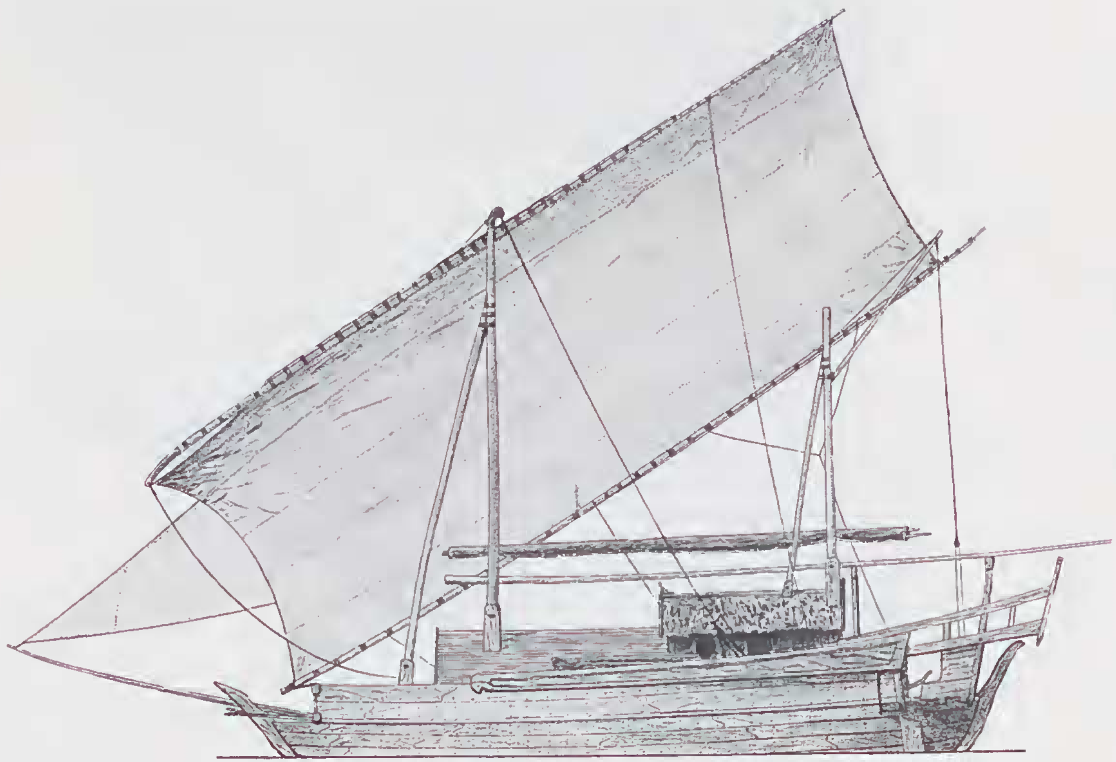

Fig. 22. Alternative reconstruction of a *perahu padewakang*. The hull form is the same but there are differences in the rig and superstructure arrangement.

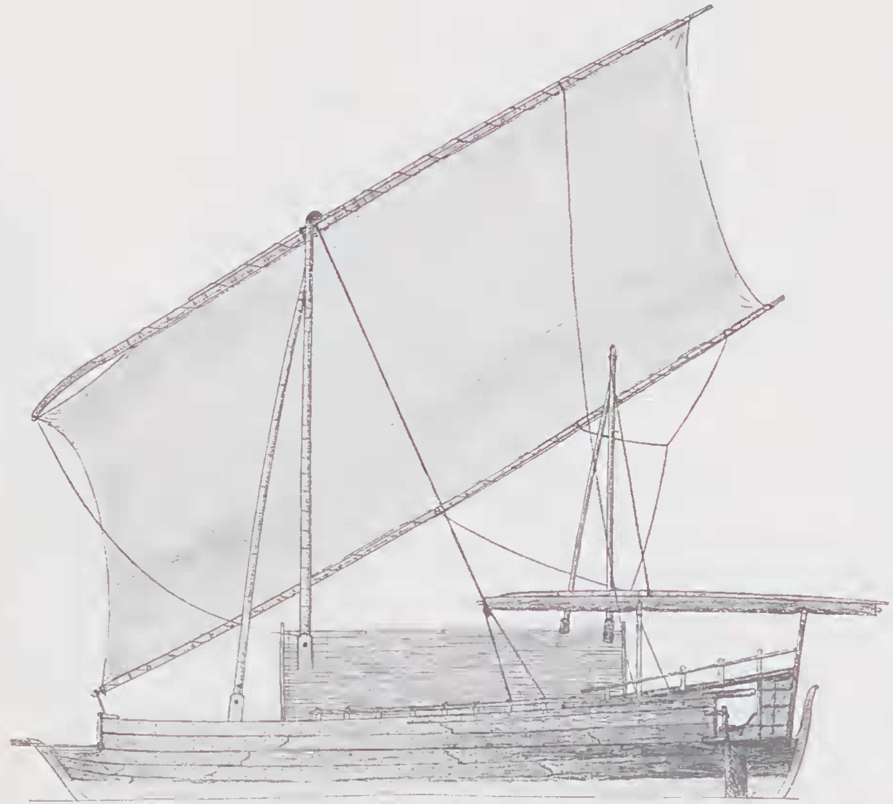

Fig. 23. Reconstruction of a *perahu padewakang* with another arrangement of rig and super structure.

The final reconstruction, as suggested in the line drawings, Figures 19 & 20 and the illustrations, Figures 21, 22 and 23, was agreed upon as being consistent with the historical evidence and consistent with the traditional knowledge of the design of sucessful seagoing, cargo carrying sailing vessels.

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